Assignment6

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AP is a shipping service that guarantees overnight delivery of packages in the continental US. The company has various hubs at major cities and airports across the country. Packages are received at hubs, and then shipped to intermediate hubs or to their final destination. The manager of the AP hub in Cleveland is concerned about labor costs, and is interested in determining the most effective way to schedule workers. The hub operates seven days a week, and the number of packages it handles varies from one day to another.The manager wants to keep the total wage expenses as low as possible while ensuring that there are sufficient number of workers available each day. Formulate and solve the problem. What was the total cost? How many workers are available each day?

```
#Loading libraries
library(lpSolveAPI)
```

```
## Warning: package 'lpSolveAPI' was built under R version 4.1.3
```

```
ap <- read.lp("ap.lp")
print(ap)
```

```
## Model name:
##             x1   x2   x3   x4   x5   x6   x7
## Minimize   775  800  800  800  800  775  750
## Sunday       0    1    1    1    1    1    0  >=  18
## Monday       0    0    1    1    1    1    1  >=  27
## Tuesday      1    0    0    1    1    1    1  >=  22
## Wednesday    1    1    0    0    1    1    1  >=  26
## Thursday     1    1    1    0    0    1    1  >=  25
## Friday       1    1    1    1    0    0    1  >=  21
## Saturday     1    1    1    1    1    0    0  >=  19
## Kind       Std  Std  Std  Std  Std  Std  Std
## Type       Int  Int  Int  Int  Int  Int  Int
## Upper      Inf  Inf  Inf  Inf  Inf  Inf  Inf
## Lower        0    0    0    0    0    0    0
```

```
#Creating a table

Workers <- matrix(c("Sunday","Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday",18,27,2

colnames(Workers) <- c("Day", "Workers")

as.table(Workers)
```

```
##   Day       Workers
## A Sunday    18
## B Monday    27
## C Tuesday   22
## D Wednesday 26
## E Thursday  25
## F Friday    21
## G Saturday  19
```

Package handlers at AP are guaranteed a five-day work week with two consecutive days off. The base wage for the handlers is $750 per week. Workers working on Saturday or Sunday receive an additional $25 per day.

```
Days_off_and_wages <- matrix(c(1,2,3,4,5,6,7,
                               "Sunday and Monday","Monday and Tuesday", "Tuesday and Wednesday", "Wedn

colnames(Days_off_and_wages) <- c("Shift", "Days_off", "Wage")

as.table(Days_off_and_wages)
```

```
##   Shift Days_off               Wage
## A 1     Sunday and Monday      $775
## B 2     Monday and Tuesday     $800
## C 3     Tuesday and Wednesday  $800
## D 4     Wednesday and Thursday $800
## E 5     Thursday and Friday    $800
## F 6     Friday and Saturday    $775
## G 7     Saturday and Sunday    $750
```

```
#Running the model

solve(ap)
```

```
## [1] 0
```

```
#Objective function (Total cost)

get.objective(ap)
```

```
## [1] 25675
```

Total cost to the firm after keeping total wage expense as low as possible while ensuring that there are sufficient workers available each day is $25,675

```
#Variables (No of workers available each day)

get.variables(ap)
```

```
## [1]  2  4  5  0  8  1 13
```

Observations:

No.of workers in shift1 = 2

No.of workers in shift2 = 4

No.of workers in shift3 = 5

No.of workers in shift4 = 0

No.of workers in shift5 = 8

No.of workers in shift6 = 1

No.of workers in shift7 = 13

Workers available to work each day in terms of the objective function and constraints:

Workers on Sunday: x2+x3+x4+x5+x6 >= 18;

Workers on Monday: x3+x4+x5+x6+x7 >= 27;

Workers on Tuesday: x4+x5+x6+x7+x1 >= 22;

Workers on Wednesday: x5+x6+x7+x1+x2 >= 26;

Workers on Thursday: x6+x7+x1+x2+x3 >= 25;

Workers on Friday: x7+x1+x2+x3+x4 >= 21;

Workers on Saturday: x1+x2+x3+x4+x5 >= 19;